CHAPTER 6

Carcass Disposal

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The most recent U.S. animal inventories reported December 2003 and January 2004, show that there are 94.9 million head of cattle, 60 million swine, 6.09 million sheep, and 449 million birds (poultry).[1] The estimated mortality of cattle averages near 2.9%, adult sheep 3.5%, feedlot lambs 2.6%, and swine 3.3%.[2] The potential annual mortality of all livestock (cattle, pigs, sheep, poultry, and horses) in the United States according to Sparks Companies 2002 was 105,345 head per day or over 3.3 million pounds.[3] There are many factors that contribute to these mortalities, such as common illnesses, infections, and respiratory ailments frequently associated with young animals and confined stock. Producers, veterinarians, and animal shelters must find secure, expedient, and economical means for disposal of these animals, road kill, and infectious wastes. In addition, livestock processors, wholesalers, and retailers must dispose of processing offals (meat waste) in the same efficient and economical manner.

An agroterrorist event involving livestock could result in enormous numbers of animal carcasses requiring disposal. These carcasses would likely be harboring an infectious agent regardless of whether the animals died from exposure to an agroterrorist agent or from euthanization to prevent suffering from or transmission of disease. The method of carcass disposal utilized will depend on a number of factors including: quantity of carcasses, cause of death, stability of potential infectious agents, local or regional environmental conditions, availability of equipment and fuel, cost, and public perception. There are a number of methods currently used to handle diseased or dying animals, their carcasses, and slaughter offals, which can potentially be applied to an emergency agroterrorist event.

One means of disposal is a form of recycling waste into otherwise useable products. Prior to the 1997 ban on feeding mammalian-derived protein sources to ruminants, and the growing concerns related to

transmissible spongiform encephalopathies (TSE), the practice of converting non-consumable animal "waste" (diseased, dead, dying and disabled animals, slaughter offal, supermarket waste, and restaurant grease) into functional meat and bone meal and tallow (i.e., rendering) consumed approximately 40 billion pounds of raw material annually.[4]

Proper and timely removal of these biological wastes in an effective manner is crucial for maintaining the health of other stock and sanitation of processing facilities.[5] Carcasses left in proximity to the herd or flock may transfer illnesses and result in further losses. They can also serve as water and environmental contaminants and expose humans to harmful bacteria such as anthrax and *Salmonella*, viruses, or protozoa such as Giradia and Cryptosporidia, or other infectious disease.[6]

Rapid and effective removal and destruction is especially important in an agroterrorist event since these carcasses can potentially propagate the spread of disease. Researchers have achieved significant progress in the search of new disposal methods such as chemical[7,8] and anaerobic digestion,[9] total de-polymerization,[10] composting,[11] and uses of recycled by-products.[12]

Carcass Disposal Methods

Past experiences with highly publicized disease outbreaks such as foot-and-mouth disease (FMD) of cloven hooved animals in the United Kingdom (UK), Chronic Wasting Disease of cervids (of the deer family) in Colorado, and exotic Newcastle disease of poultry in California, have demonstrated need for cost-effective, safe, fast, complete, and environmentally acceptable disposal methods. There are several alternative methods of biological waste disposal that can be employed. The rendering method selected should be based upon operational objectives and state and/or federal regulations. These regulations are generally based upon the method's impact upon disease control and air and water quality. While state laws regarding livestock disposal vary widely, most require disposal to take place within 24 to 48 hours. Nationally, the approved methods include: rendering, composting, burial, landfilling, incineration, and tissue digestion. Each of these disposal methods has useful attributes, but also possesses undesirable qualities.[13]

Rendering

Rendering is an economically viable and effective means of recycling biological waste into usable products for the feed and oleo chemical industries. "In 2002, 36 million head of cattle, 100 million pigs, and nearly nine billion chickens and turkeys were slaughtered in the United States, yielding 85.5 billion pounds (38.8 million metric tons) of meat, an increase of 3.3 percent over 2001, and 18.8 billion pounds (8.5 million tons) of rendered product, an increase of 3.4 percent."[14] Daily, the rendering industry processes biological waste, converting this unusable material into edible fats and oils; and inedible lard, tallows, greases, meat meal, meat and bone meal, and dry rendered tankage. These products and other derivatives of the rendering industry are vital in manufacturing plastics, tires, antifreeze, jet fuel, biodiesel, lotions, soaps, candles, and numerous other common household items.[15]

The current rendering industry is divided between two types of facilities—independent plants and integrated rendering plants which are associated with livestock and poultry packing/processing facilities. While the source of animal by-products from an integrated plant is "known" material generated from the processing plant, independent renderers gather "unknown" materials from numerous sources including very small processing plants, restaurants, animal shelters, feedlots, dairies, and ranches.[16] Currently, 70% of all products are rendered at integrated rendering plants.[17] Many independent companies have been acquired by larger independent renderers, or have gone out of business. A great deal of this change in business structure is due to the Food and Drug Administration's (FDA) implementation of Title 21 Part 589.2000 of the Code of Federal Regulations, August 4, 1997, which prohibited the use of most mammalian protein in feeds for ruminant animals.[18]

Composting

Composting is a natural process in which bacteria and fungi decompose organic material in an aerobic environment. As microorganisms break down the organic material, energy, in the form of heat, is produced. This heat, when sustained between 130°F and 150°F for one week, will kill weed seeds and bacterial pathogens found in raw

organic matter,[19] and results in compost, which resembles humus.[20] Compost can be used as a soil amendment on farms, parks, and lawns and can be especially beneficial to "organic" farmers as a soil nutrient source. However, the composition of the finished compost can vary greatly due to differences in management and input materials.[21] Composting of carcasses has been an effective alternative to pit burial because it reduces waste volume and the recycled waste can be subsequently reused.[22]

Composting biological waste produces a usable end product, but the success of composting depends on proper site planning and monitoring of the operation.[23] Management issues include raw material, moisture and temperature control, and proper proportions of nitrogen and carbon sources.[24] Optimally, the internal temperature will remain at or above 130°F for three consecutive days such that pathogenic bacteria are destroyed. If temperatures exceed 150°F, all bacteria can be destroyed, ceasing the composting process. Odor from compost is another concern which can be regulated by balancing the carbon and nitrogen content at or above a 25:1 C:N ratio.[25]

Facility design should also address odor control and appropriate compost site location.[26] While regulations vary by individual states, in general, safely composted products must meet the following criteria before being sold or distributed:[27]

1. Minimum of two heat cycles with temperatures reaching 130°F during each cycle,
2. No visible soft tissue in finished compost, and
3. Handling and storage of the compost must adhere to state or local regulations.

Burial

Instances of livestock burial date back 6,000 years.[28] This method is inexpensive and requires only the use of common farm implements. Burial can be used to avoid attracting predators and scavengers and as a means for preventing further spread of contagious diseases. Burial sites should be monitored for evidence of disturbances by coyotes, rodents, and flies. Burial sites should also be capped with a mound of dirt; and grass should be reintroduced to prevent erosion.[29] While burial does not initially reduce

the volume of biological waste, over time carcasses naturally decompose into humus through microbial and chemical processes.

One effective type of carcass burial is trench burial. As described by the Utah State University Extension Service, trench burial can be accomplished by digging a trench seven feet wide and nine feet deep and as long as necessary for the desired number of mature cows. The cows are placed in the trench and covered with a layer of dirt. The Utah State University Extension Service contends that deeper burial controls odors, helps to prevent the spread of disease, and keeps the carcass out of sight.[30]

In recent years, much concern has arisen over environmental contamination due to burial. Potential contamination of water and soils with diseases, chemicals, and bacteria are major concerns. In addition to hazardous environmental risks, urbanization rates have created an issue of recovering and removing buried animal remains prior to selling property. Burial, while inexpensive and readily employed for years, may no longer be considered a responsible option for animal disposal in many locales.

Landfilling

Landfilling animal remains in solid municipal waste areas is widely used, however regulations are inconsistent from county to county and state to state. These landfill waste areas must have a permit for operation, and be licensed to accept these types of waste. Landfills have authority to limit the number of dead animals accepted and can assign a fee to accept biological waste. Many older landfills that have evolved from former town or county dumps, may not yet comply with newer Environmental Protection Agency standards for landfill design. Therefore, the potential exists for the introduction of landfill pollutants to land or surface water. Modern landfills, which are capped to prevent water entry and lined to prevent to migration of leachate to groundwater, have minimized the groundwater pollution concerns.[31] A major concern with landfilling is the issue of space. According to the Environmental Protection Agency, 70% of U.S. landfills will reach capacity by 2025.[32]

Incineration

Incineration is among the most biologically safe methods of animal disposal included in this discussion with respect to destruction of infectious

agents.[33] Incineration effectively destroys all infectious agents, transforming organic material into inorganic material through the exposure to high (1652°F) temperatures.[34] Incineration poses minimal threat to water quality and effectively prevents the transmission of infectious diseases, including transmissible spongiform encephalopathies-causing prions. Ash generated from these processes can be safely disposed in controlled landfills or utilized as aggregate or other construction materials.[35]

To facilitate greater capacity, larger incinerators are being put into use. These larger incinerators produce more particulate matter and therefore must incorporate equipment to minimize emissions of particulate matter, heavy metals, and acidic gases.[36] Any burning done for disposal purposes must abide by clean-air standards regulated by the Environmental Protection Agency and is subject to regular inspections to ensure proper maintenance and function of equipment.[37]

Tissue Digestion (Alkaline Hydrolysis)

Chemical tissue digestion is a newer method of animal disposal primarily used by diagnostic laboratories such as those located near veterinary research centers and teaching hospitals. These digesters use boiling sodium or potassium hydroxide solutions to degrade protein and fat into a neutral solution of amino acids, peptides, sugars, and soap that is suitable for release into a municipal sewage system; and sterile calcium phosphate residue from teeth and bones that can be disposed of in an approved landfill.[38] The large volume of effluent that is released into the sewer can pose a difficult challenge due to high biological oxygen demand that may overwhelm city sewer systems. While this tissue digestion process does eliminate infectious agents, it is volume limited (up to 7,000 lbs) and time consuming (greater than 4 hours), and requires large capital expenditures for equipment and facilities. New generation tissue digesters have the potential to increase volume capacity, reduce effluent handling difficulties, and lower initial capital costs of equipment.[39]

Type and Magnitude of Military Support

Following an agroterrorism attack, there are several factors which will determine the type and magnitude of support required. Those factors

include: the epicenter of the event, the surrounding livestock populations, the surrounding human populous, and what species were involved. Individual events will vary widely in terms of climate, geographical terrain, and livestock and people densities.

In actual global disease outbreak situations (UK and Uruguay), the military was called upon to provide human, security, and logistical resources to the 2001 foot-and-mouth disease outbreaks. The involvement of the military in both instances has been viewed as successful and integral in the rapid control and eradication of the disease. The role of the military in responding to the 2001 foot-and-mouth disease outbreak in the UK was viewed as favorable, particularly, their expertise in emergency, logistical and operational management.[40]

In many infectious foreign animal disease events, the disease of concern is often not ultimately responsible for the death of livestock. Often, depopulation is utilized as a means of preventing additional spread of the agent. In these scenarios the contribution of trained individuals who can assist with large-scale livestock depopulation would be valuable.

Because effective and accepted methods of carcass disposal require some type of infrastructure, the actual process of disposal may be outside the reaches of the military. However, the military may provide access to heavy equipment and transportation mechanisms needed to mobilize disposal equipment and supplies. Additionally, the military may ensure secure transportation of carcasses to a central disposal location. The Department of Defense (DoD) could potentially assist in contracting these resources from the private sector.

Excavation equipment and operators for onsite development of the site and handling of carcasses would be needed if burial, pit incineration, or composting were employed in the disposal operation. These resources would likely be contracted from the private sector with the assistance of DoD contracting agents and specialists. Additionally, for any operation requiring real estate resources, there is a possibility of the U.S. Army Corps of Engineers employing their Contingency Real Estate Support Team for the purposes of rapidly securing land leases and finalizing real estate transactions.

Conclusions and Follow-up Actions

The first question that must be addressed is: "When should the Department of Defense become involved?" Based on the debriefings from Uruguay and the UK, it is clear that the DoD should be informed of the emergency at the onset. The DoD involvement would be determined based upon the scale (single state, multi-state, national, international), magnitude (number of people, livestock, or farms affected) and scope of each individual event. In some instances, DoD may not have, or be able to supply support, given the current status of the agricultural event and military resources.

In the circumstance that DoD resources are needed and available, the likely areas of support would involve security, contracting (private sector support and real estate), organization, and emergency response expertise through incident command type structures. For instance, the following DoD communication channels and areas of involvement in an animal emergency response should be explored:

1. *Who or what office is the first point of contact for the DoD?*

   This individual or office should be contacted at the onset of any emergency animal response, regardless of cause. The involvement of DoD would then be determined based upon the current situation and needs.

2. *What personnel and security resources are available?*

   In both the UK and Uruguay events, early military involvement in area quarantine and restriction of animal movement were critical in minimizing the spread of the infectious agent. These resources would likely be short-term, immediate needs of the response effort.

3. *Who is the contact for contracting?*

   The most probable DoD resource that would be utilized in any emergency response would be contracting expertise. Service and equipment needs will likely be provided through USDA or DoD contracts with third party providers.

4. *Who is the contact person for the United States Army Corps of Engineers?*

   For large-scale animal disposal, the United States Army Corps of Engineers has infrastructure in place to oversee and administer real property, geological analyses and engineering and potential construction (i.e., landfill or compost site).

An attack on our U.S. agriculture has the potential to generate millions of carcasses requiring immediate disposal. Current civilian facilities may not be able to transport and process these great quantities of biological waste without federal assistance. The DoD possesses critical capabilities and manpower which can be utilized in the event of an agroterrorist event or major natural outbreak of disease in the United States. These capabilities and manpower must be identified and employed to prevent further propagation of agroterrorist or naturally occurring diseases.

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